

# Infant feeding and risk of severe diarrhoea in Basrah city, Iraq: a case-control study

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*A case-control study of the relationship between feeding mode and risk of hospitalized diarrhoea in infants (aged 2–11 months) in Basrah city was conducted between September 1983 and May 1984. A total of 597 cases were recruited from among infants admitted with diarrhoea to the major paediatric hospital in the city, while 723 controls were recruited from among healthy infants attending any of the seven maternal and child health clinics in Basrah. A variety of potentially confounding variables were controlled in the analysis. For infants aged 2–5 months, breast-feeding alone or breast-feeding plus food were the least risky feeding modes. Bottle-feeding was dangerous and bottle-feeding alone was associated with a risk of 55 among infants aged 2–3 months, and 37 among infants aged 4–5 months, relative to exclusive breast-feeding. For older infants (6–11 months), the risks of hospitalized diarrhoea were not significantly different among different partial breast-feeding modes, but non-breastfeeding was dangerous, especially exclusive bottle-feeding. Food intake was associated with a reduced risk of severe diarrhoea among bottle-fed infants but not with an increased risk among breast-fed infants. Among bottle-fed infants, no association was found between risk of severe diarrhoea and method of bottle-cleaning. Previous breast-feeding conferred no current protection.*

## Introduction

Diarrhoeal morbidity and mortality rates are high among infants and young children in developing countries. This is also true in Iraq (1, 9).<sup>a,b</sup> Biological data suggest an important protective role for breast-feeding against diarrhoea, especially early in infancy (7, 12). Two recent reviews on the epidemiological evidence for such protectiveness support this hypothesis (5).<sup>c</sup> Our knowledge of the relationship between infant feeding and diarrhoea is not, however, as detailed and comprehensive as it should be, partly owing to the complexity of the methodological problems inherent in measuring this association (13).

The use of case-control methods in studies of diarrhoeal diseases has, until recently, been limited to the investigation of diarrhoea outbreaks. However, during the last few years, these methods have been increasingly applied to the investigation of diarrhoea risk factors, and to the evaluation of the impact on diarrhoea of various interventions (3, 14).<sup>d,e</sup>

The present study investigated the impact of infant feeding practices on the risk of hospitalized diarrhoea in infancy in Basrah city, Iraq, using a case-control methodology. The field work was conducted over a period of 9 months between September 1983 and May 1984.

## Materials and methods

Basrah city, with about 750 000 inhabitants, is situated on the western bank of the Shatt-al-Arab waterway in southern Iraq. Health services in the city are mainly provided by the government health facilities, free of charge. All inpatient paediatric health services during the study period were provided by the Basrah Paediatric Hospital (BPH). There are seven maternal and child health clinics (MCHC) in Basrah city, providing preventive health care services only (immunization and monitoring of growth and development). Immunization against diphtheria, pertussis, tetanus, and poliomyelitis is compulsory in Iraq.

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<sup>b</sup> Mahmood, D.A. A study on the perceived needs and the utilization of health care services in a rural Iraqi area. M.Sc. thesis, London School of Hygiene and Tropical Medicine, University of London, 1982.

<sup>c</sup> Mahmood, D.A. Feeding practices and risk of severe diarrhoea among infants in Basrah, Iraq: a case-control study. Ph.D. thesis, London School of Hygiene and Tropical Medicine, University of London, 1988.

<sup>d</sup> Briscoe, J. et al. Measuring the impact of water supply and sanitation facilities on diarrhoea morbidity: prospects for case-control methods. Unpublished WHO document WHO/CWS/85.3 and CDD/OPR/85.1.

<sup>e</sup> Cousens, S.N. et al. Case-control studies of childhood diarrhoea. 1. Minimizing bias. Unpublished WHO document CDD/EDP/88.2.

**Cases.** A case in this study was defined as an infant (below one year of age) who was admitted to the Basrah Paediatric Hospital during the study period because of diarrhoea with or without other signs or symptoms (e.g., vomiting, dehydration, fever, respiratory symptoms), with an onset of diarrhoea not more than five days before admission. Excluded from these were: (a) infants with a birthweight of less than 2500 grams; (b) infants of mothers who had severe illnesses during pregnancy, delivery, and/or puerperium, and required hospitalization; (c) infants with congenital malformation, chromosomal abnormalities, and chronic debilitating diseases; (d) infants residing outside Basrah city; and (e) infants, 3 months of age and older, with no history of being taken to an MCHC for immunization. On each day of the study period the hospital was visited by one of us (DAM), and case notes of all newly admitted infants were inspected. Infants with diarrhoea as their chief complaint were chosen as potential cases and those who satisfied the above criteria were selected for the study.

**Controls.** Controls were selected from infants brought to any of the seven MCHCs in Basrah city for immunization and/or routine check-up during the study period. They should not have had a history of admission to hospital because of diarrhoea in the month prior to the interview, and were excluded if admitted to hospital for diarrhoea during a period of one month following selection as a control. Excluded were infants who fell in categories (a) to (d) mentioned above.

Each MCHC was visited once during each of six five-week subperiods. The initial visit to each clinic was in a randomly selected week in the first five-week subperiod, after which the visits were made systematically (every fifth week). The visits were made on one of the three days each week when the MCHCs had infant welfare clinics, randomly choosing a different day each time. Every other infant entering the room to be seen by the nurse in charge was selected as a potential control.

Subject to the above definitions, cases could later become controls and vice versa. For all study subjects, informed consent was obtained from mothers after explaining the nature and purpose of the study.

#### **Data collection and analysis**

Data in this study were compiled from three sources:

— Interviews of infants' mothers conducted in Arabic (by DAM); precoded questionnaires were used and information gathered included socioeconomic characteristics of the family, infant feeding practices, and, for the cases, details of the symptoms of the presenting illness.

— Hospital records for information on clinical features, treatment, and prognosis of cases.

— Diagnostic laboratory tests on faecal specimens to detect enteropathogenic *Escherichia coli* (EPEC) and rotavirus. Laboratory procedures are reported elsewhere (9).

Odds ratios for estimating relative risks of hospitalized diarrhoea among various feeding mode groups, while controlling for the effects of confounding variables, were obtained using linear logistic regression analysis. Both SPSS (Statistical Package for Social Sciences) and PECAN (Parameter Estimation in Conditional Analysis), which employs the conditional maximum likelihood method to estimate the required parameters, were used for conducting the analysis.

The following variables were found to act as confounders and were therefore controlled for in the analysis:

- infant's age (in months);
- month of selection of the study subject;
- years of school education of the mother;
- place of residence (divided into affluent, intermediate, and poor);
- sex;
- ownership of a house;
- ownership of a car;
- type of house in which the family lives (brick, mud, or reed); and
- type of infant's drinking water (boiled vs unboiled).

The first four of these were found to be the most important confounding variables.

Interactions between the effect of infant feeding and of each infant's age and various socioeconomic variables on the diarrhoea were also considered. A statistically significant interaction between infant feeding and infant's age on risk of hospitalized diarrhoea was detected. Hence the results are presented within four age groups of infancy: 2–3, 4–5, 6–7, and 8–11 months. Infants in the first two months of life (infants of 0 and 1 month of age) were excluded from the analysis because they were few in number. No significant interactions were found between infant feeding and socioeconomic variables.

Various feeding modes are contrasted with exclusive breast-feeding for infants aged 2–5 months (the widely recommended feeding mode during that age span) and with breast-feeding and food for those aged 6–11 months (because of its nutritional desirability later in infancy).

#### **Definitions of feeding modes**

Feeding modes were divided according to the presence in the diet of breast-feeding (BF), bottle-feeding (BTL) and food (all items in the diet other than BF, BTL, water, water and sugar) into: exclusive breast-feeding

(EBF), partial breast-feeding (PBF), and non-breast-feeding (non-BF). EBF infants had neither BTL nor food in their diet. PBF infants were either on BF + food (PBF/BF + food), or BF + BTL + food (PBF/BF + BTL + food), or BF + BTL (PBF/BF + BTL). Non-breastfed infants could either be on BTL + food (non-BF/BTL + food), or on BTL only (non-BF/BTL-only).

Feeding practices obtained for cases were those prevalent before the beginning of the current illness. For controls, the feeding practices prevalent at the time of the interview were recorded.

## Results

Table 1 shows the number of cases and controls enrolled in the study by age group.

### Risk of hospitalized diarrhoea

**Among infants aged 2–5 months.** The relative risks (RRs) of hospitalized diarrhoea for various feeding modes compared with EBF (the recommended feeding mode in this age group) are shown in Table 2. The risk among PBF infants (irrespective of feeding mode subdivisions or number of breast-feedings per day) is higher than that for EBF infants in both age groups, though not significantly so in the 4–5-month group. The RRs for infants with 3 or less breast-feedings per day (PBF/3-) are higher than the corresponding RRs for those with 4 or more breast-feedings per day (PBF/4+) in both age groups. PBF infants on breast and bottle-feeding, with food (PBF/BF + BTL + food) or without food (PBF/BF + BTL), have an increased risk of hospitalized diarrhoea. Those on breast-feeding and food (PBF/BF + food), however, have a lower risk than those exclusively breast-fed, although not significantly so.

The RRs of hospitalized diarrhoea among non-BF infants, contrasted with EBF infants, are extremely high in both age groups and greater than those for partial breast-feeding. Also, the RRs for non-BF/BTL-only are much higher than those for infants on non-BF/BTL + food.

**Among infants aged 6–11 months.** RRs of hospitalized diarrhoea for various feeding mode groups (except EBF, which is not recommended in this age group),

Table 1: Number of cases and controls included in the logistic regression analysis

Age group (months)	Cases	Controls
2–3	191	193
4–5	164	267
6–7	103	146
8–11	139	117
2–11	597	723

Table 2: Relative risks of hospitalized diarrhoea among various feeding groups compared to exclusive breast-feeding, by age group

Feeding mode <sup>a</sup>	Relative risk, by age group	
	2–3 months	4–5 months
EBF	1	1
PBF (all)	6.2 (2.8–14.0) <sup>b</sup>	2.9 (0.9–9.9)
PBF/3–	12.1 (4.4–33.3)	4.7 (2.0–11.1)
PBF/4+	5.2 (1.5–18.0)	1.4 (0.4–4.5)
PBF/BF + BTL	8.4 (3.5–19.9)	6.6 (1.8–24.4)
PBF/BF + food	0.3 (0.1–2.1)	0.9 (0.5–9.4)
PBF/BF + BTL + food	8.5 (2.8–26.2)	2.2 (0.5–9.4)
Non-BF (all)	36.7 (14.6–92.4)	23.8 (7.1–80.5)
Non-BF/BTL-only	54.7 (20.5–146.0)	36.9 (10.3–98.4)
Non-BF/BTL + food	7.6 (2.3–25.2)	14.6 (4.0–53.1)

<sup>a</sup> See text (pp. 702–703) for explanation of feeding modes.

<sup>b</sup> Figures in parentheses are the 95% confidence intervals.

compared with PBF/BF + food (the recommended feeding mode in this age group) are shown in Table 3. Among PBF infants, those taking breast plus bottle milk (PBF/BF + BTL), and those also taking food (PBF/BF + BTL + food), have risks that are not significantly different from unity. Among non-BF infants, those taking bottle milk alone (non-BF/BTL-only) have a significantly higher risk compared to those on PBF/BF + food. This is also true, although to a lesser extent, for infants aged 6–7 months who were taking food in addition (non-BF/BTL + food).

### Impact of bottle-cleaning, breast-feeding, and food intake among bottle-fed infants

Those infants who were bottle-fed were studied with respect to each of the following: bottle cleaning method, breast-feeding, and food intake, while controlling for the effect of the other two factors (Table 4). Absence of either breast-milk or food in the diet was associated with a significantly raised risk. Sterilization of bottles, however, showed no significant association with hospitalized diarrhoea.

Table 3: Relative risks of hospitalized diarrhoea among various feeding groups compared with PBF/BF + food, by age group

Feeding mode <sup>a</sup>	Relative risk, by age groups	
	6–7 months	8–11 months
PBF/BF + food	1	1
PBF/BF + BTL	1.7 (0.5–5.9) <sup>b</sup>	2.1 (0.2–29.0)
PBF/BF + BTL + food	0.8 (0.3–2.1)	0.5 (0.2–1.2)
Non-BF/BTL-only	4.9 (1.6–14.9)	9.1 (1.9–42.7)
Non-BF/BTL + food	3.9 (1.5–9.7)	0.9 (0.4–1.8)

<sup>a</sup> See text (pp. 702–703) for explanation of feeding modes.

<sup>b</sup> Figures in parentheses are the 95% confidence intervals.

### Impact of previous state of breast-feeding

RRs of hospitalized diarrhoea were obtained, by age group, for infants never breast-fed (Never-BF), compared with infants who were on breast-feeding at some time in the past (Pre-BF) but were not currently breast-fed. The RRs were not significantly different from unity in any age group. Pre-BF infants were divided into two groups according to the interval between stopping breast-feeding and enrolment in the study: those in whom breast-feeding was stopped within the previous two months (Pre-BF/2mo-), and those in whom it was stopped more than two months before (Pre-BF/3mo+). Risk of hospitalized diarrhoea in these two groups were similar within each age group.

## Discussion

### Methodological issues

The present study design was based on incidence density sampling, in which the exposure histories of incident cases were compared with the exposure histories of non-cases who were still at risk of becoming cases (8). The study-base was defined as the population of infants who would have been brought to the hospital if they developed the study disease during the study period (10). BPH was the only paediatric hospital in Basrah in operation at the time of the study, and most health services were free of charge. Thus there was little likelihood of differential reporting of diarrhoea cases severe enough to require hospitalization. In addition, immunization is compulsory and therefore the infants recruited at the MCHCs can be considered representative of the study-base.

Extensive control was made in the analysis for factors thought to be confounding the relationship between infant feeding and diarrhoea. Although it is difficult to know whether all confounders were controlled, confounding is an unlikely explanation for the strong relationships found in this study.

Another potential source of bias in such a study is

the fact that infant feeding mode may well be changed by the mother at the onset of the illness. This source of bias was avoided by defining the feeding mode for cases as the one that was prevalent before the beginning of the episode of diarrhoea that brought the infant to the hospital.

### Infant feeding related to diarrhoea

It is widely recommended on nutritional and other grounds that infants be exclusively breast-fed during the first 4–6 months of infancy and that breast-feeding should be supplemented by appropriate foods during the later part of infancy. To draw out the policy implications of our results, we therefore analysed our findings with these recommendations in mind (Tables 2 and 3).

For infants 2–5 months of age, our findings show that exclusive breast-feeding and breast-feeding plus food were equally safe and were highly preferable to other feeding modes which all included bottle-feeding. In this population, bottle-feeding was extremely harmful in young infants and the early introduction of supplementary foods had no detrimental effect. Breast-feeding together with bottle-feeding was dangerous, especially early in infancy, but, if practised, was safer with more frequent breast-feeds. For older infants (6–11 months), the risks of hospitalized diarrhoea were not significantly different among the different partial breast-feeding modes. Non-breastfed children, however, were at greater risk, especially those receiving only bottle milk. Throughout infancy, therefore, the risks of hospitalized diarrhoea were highest, compared to the desired feeding modes, for those fed exclusively on bottle milk. These risks were lessened if either breast milk or food were given in addition to bottle milk.

The beneficial effect of food intake in reducing the risk of severe diarrhoea among bottle-fed infants is supported by a recent case-control study from Brazil, which concluded that the addition of a non-milk supplement to the diet of infants already receiving milk other than breast milk was associated with a small reduction in the risk of diarrhoea mortality (14). Our finding of a reduced risk of hospitalized diarrhoea associated with food intake may be attributed to one or more of the following.

- Intake of food supplements among infants is more prevalent among the wealthier sectors of the community who at the same time have a lower incidence of hospitalization for diarrhoea. This explanation is, however, unlikely in view of the extensive control for socioeconomic variables in the analysis.
- Infants with food supplements in their diet are better nourished than those without such intake, with the result that the former are less liable to severe diarrhoea than the latter. However, a higher protective effect of

Table 4: Impact of bottle-cleaning method, breast-feeding, and food intake on risk of hospitalized diarrhoea among bottlefed infants, by age group

Feeding groups (all bottle feeding)	Relative risk, by age group	
	2–5 months	6–11 months
Non-sterilizing vs sterilizing*	1.1 (0.6–1.4) <sup>b</sup>	1.4 (0.7–2.3)
No breast-feeding vs breast-feeding	5.0 (3.2–7.7)	3.1 (1.6–5.9)
No food vs food	2.7 (1.7–4.2)	2.3 (1.2–4.7)

\* Sterilization = boiling of bottle and teat or use of sterilizing tablets.

<sup>b</sup> Figures in parentheses are the 95% confidence intervals.

food supplements in the first six months of life when the nutritional importance is probably least, compared with later in infancy, does not support this explanation.

- Intake of food supplements may be less hazardous than bottle-feeding, owing to less bacterial contamination. A study in Uganda, which showed that 22% of cups and spoons used in infant feeding had a satisfactory bacteriological count compared with only 2% of bottles and teats (11) supports this explanation.

Although bottle-feeding was associated with the highest risks of hospitalized diarrhoea, we found no association with the method of bottle-cleaning. One or more of the following explanations may account for this.

- Boiling of bottles and teats or use of sterilizing tablets are not conducted properly, or contamination is introduced after bottle-cleaning by unhygienic handling of the bottle and/or the milk.
- Proper procedures in bottle-cleaning are closely linked with the socioeconomic status of the community. Strict control for socioeconomic characteristics in the analysis would, therefore, conceal the effect of the bottle-cleaning method on the risk of severe diarrhoea.
- Bottle and teat contamination is a less important issue in the causation of hospitalized diarrhoea than the lack of active protection of breast-feeding.

Elegbe et al. (4), in a study of bacterial contamination of teats by the method of cleaning, showed that while among educated mothers 56% of teats cleaned by sterilizing tablets had satisfactory bacterial counts, only 20% of teats cleaned by the same method by illiterate mothers had such counts. This would support the second explanation above.

We found that throughout infancy those children who were previously breast-fed had similar risks of hospitalization compared to those in the corresponding age groups who were never breast-fed. Also, the duration of time since breast-feeding was stopped did not seem to have any impact on the risk. This suggests that protection derived from breast-feeding depends on the presence of breast milk in the diet, and that this protectiveness ceases after breast-feeding is stopped. These findings support those of Ferguson et al. (6).

#### **Implications for diarrhoeal disease control in Basrah city.**

With the strong evidence of a causal association between infant feeding and hospitalized diarrhoea, the proportions of hospitalized diarrhoea cases that would not have occurred if the risky feeding practices were eliminated (the population attributable risks (ARp) or etiological fraction) were computed. ARps in each age group, changing all infants aged 2–5 months to EBF and all infants aged 6–11 months to PBF/BF + food, are given in Table 5, calculated using the method proposed by Bruzzi et al. (2). A large proportion of

**Table 5: Population attributable risk (ARp) of hospitalized diarrhoea associated with non-ideal infant feeding, by age group**

Age (months)	Percentage reduction in hospitalized diarrhoea cases if all infants followed the ideal feeding mode for their age <sup>a,b</sup>
2–3	86
4–5	87
6–7	41
8–11	0 <sup>c</sup>
2–7	77
2–11	60

<sup>a</sup> Calculated by the method of Bruzzi et al. (2).

<sup>b</sup> Ideal feeding modes were defined as exclusive breast-feeding (EBF) for infants aged 2–5 months and breast-feeding plus food (PBF/BF + food) for infants aged 6–11 months.

<sup>c</sup> Conservatively assumed to be zero (see Table 3).

hospitalized infantile diarrhoea cases (60% of those aged 2–11 months) could, in theory, be prevented by these changes in feeding mode.

Table 6 shows the theoretical percentage reductions in diarrhoeal admissions to the hospital, taking into consideration the possible impact of breast-feeding promotion projects in changing the infant feeding practices. Data on such impacts were obtained from Feachem & Koblinsky (5). Projects of high impact could cause a reduction of just over a quarter of diarrhoeal admissions in the first year of life, with a much higher percentage reduction during the first half of infancy when diarrhoeal mortality is highest. A project of low impact, however, may produce a decline of only 7% of admissions during the first year of life, with a 12% decline among infants aged 2–3 months.

Our results and theoretical calculations suggest that well-designed breast-feeding promotion projects should constitute an important part of a multifaceted diarrhoeal disease control programme in Basrah city,

**Table 6: Percentage reduction in number of hospitalized diarrhoea cases at the Basrah Paediatric Hospital, in various age groups, attributable to breast-feeding promotion projects of varying impacts<sup>a</sup>**

Age group (months)	% reduction in hospitalized diarrhoea		
	High impact	Moderate impact	Mild impact
2–3	47	24	12
4–5	30	15	7
6–7	8	4	2
8–11	0	0	0
2–11	26	13	7

<sup>a</sup> Further details in reference 5.

and probably elsewhere in Iraq and in other developing countries. The study showed that the impact of such interventions would be greatest among younger infants with a consequent greater impact on diarrhoea-related mortality, which is highest in this age group.

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## Résumé

### Alimentation des nourrissons et diarrhée: étude cas-témoins à Basrah (Iraq)

Une étude cas-témoins portant sur les liens entre le mode d'alimentation et le risque de diarrhée nécessitant l'hospitalisation a été menée de septembre 1983 à mai 1984 à Basrah chez des nourrissons âgés de 2 à 11 mois. Au total, 597 cas ont été retenus parmi les enfants admis pour diarrhée au principal hôpital pédiatrique de la ville, tandis que 723 enfants en bonne santé ont été choisis dans les sept cliniques de santé maternelle et infantile de Basrah pour servir de témoins. Un certain nombre de facteurs confondants potentiels ont été pris en compte dans l'analyse.

Pour les enfants âgés de 2 à 5 mois, les modes d'alimentation les moins dangereux étaient l'allaitement au sein exclusif et l'allaitement au sein accompagné d'une autre forme de nourriture (à l'exclusion du biberon). L'usage du biberon était dangereux, et lorsque ce mode d'alimentation était utilisé seul, le risque relatif par rapport à l'allaitement au sein exclusif était de 55 pour les nourrissons âgés de 2 à 3 mois et de 37 pour ceux âgés de 4 à 5 mois. Pour les enfants plus âgés (6 à 11 mois), les risques associés aux différents modes de sevrage partiel ne présentaient pas de différence significative, mais le sevrage total était dangereux, les enfants nourris exclusivement au biberon étant les plus exposés. L'absorption de nourriture sous une autre forme s'accompagnait d'une réduction du risque de diarrhée grave chez les enfants nourris au biberon, mais elle ne paraissait pas avoir d'effet défavorable sur les enfants nourris au sein. Aucune association n'a été observée entre le risque de diarrhée grave chez les enfants nourris au biberon et la méthode de nettoyage du biberon. Le fait qu'un enfant ait été nourri au sein antérieurement ne lui conférait aucune protection par la suite.

Ces résultats et des calculs théoriques donnent

à penser qu'une campagne bien conçue en faveur de l'allaitement maternel pourrait constituer une importante facette d'un programme complet de lutte contre les maladies diarrhéiques, non seulement à Basrah, mais probablement ailleurs en Iraq et dans d'autres pays en développement. L'étude montre que l'effet d'une telle intervention se ferait surtout sentir sur les plus jeunes enfants, et par conséquent que son impact serait particulièrement marqué sur la mortalité diarrhéique, qui est maximale entre 2 et 5 mois.

## References

1. Amin-Zaki, L. et al. Infantile diarrhoea in Iraq: a study of 416 hospital cases. *Pakistan paediatric journal*, **1**: 87-94 (1971).
2. Bruzzi, P. et al. Estimating the population attributable risk for multiple risk factors using case-control data. *American journal of epidemiology*, **122**: 904-914 (1985).
3. Clemens, J.D. et al. Breast-feeding as a determinant of severity in shigellosis: evidence for protection throughout the first three years of life in Bangladeshi children. *American journal of epidemiology*, **123**: 710-720 (1986).
4. Elegbe, I.A. et al. Pathogenic bacteria isolated from infant feeding teats: contamination of teats used by illiterate and educated nursing mothers in Ile-Ife, Nigeria. *American journal of diseases in children*, **136**: 672-674 (1982).
5. Feachem, R.G. & Koblinsky, M.A. Interventions for the control of diarrhoeal diseases among young children: promotion of breast-feeding. *Bulletin of the World Health Organization*, **62**: 271-291 (1984).
6. Fergusson, D.M. et al. Breast-feeding, gastrointestinal and lower respiratory illness in the first two years. *Australian paediatric journal*, **17**: 191-195 (1981).
7. Hanson, L.A. et al. Protective factors in milk and the development of the immune system. *Pediatrics*, **75** (suppl.): 172-176 (1985).
8. Hogue, C.J. et al. Estimators of relative risk for case-control studies. *American journal of epidemiology*, **118**: 396-407 (1983).
9. Mahmood, D.A. & Feachem, R.G. Clinical and epidemiological characteristics of rotavirus and EPEC-associated hospitalized infantile diarrhoea in Basrah, Iraq. *Journal of tropical pediatrics*, **33**: 319-325 (1987).
10. Miettinen, H.C. The case-control study: valid selection of subjects. *Journal of chronic diseases*, **7**: 543-548 (1985).
11. Phillips, I. et al. Methods and hygiene of infant feeding in an urban area of Uganda. *Journal of tropical pediatrics*, **15**: 167-171 (1969).
12. Pittard, W.B. Breast milk immunology: a frontier in infant nutrition. *American journal of diseases of children*, **133**: 83-87 (1979).
13. Sauls, H.S. Potential effect of demographic and other variables in studies comparing morbidity of breast-fed and bottle-fed infants. *Pediatrics*, **64**: 523-527 (1979).
14. Victoria, C.G. et al. Evidence for protection by breast-feeding against infant deaths from infectious diseases in Brazil. *Lancet*, **2**: 319-321 (1987).